Goliath Grouper Data Workshop Report

Introduction

The goliath grouper SEDAR Data Workshop was held from 8:30 AM March 5 through 11AM March 6, 2003. Stu Kennedy of Florida Fish and Wildlife Commission's Florida Marine Research Institute (FWC-FMRI) was the convener; the participants are listed in Appendix 1. Stephania Bolden and Anne-Marie Eklund served as rapporteurs for the first and second days respectively.

The terms of reference for the workshop were to determine the quality and appropriateness of data available for an assessment. The participants agreed to place all data needed for an assessment on a CD, which would be provided to the Gulf of Mexico, South Atlantic, and Caribbean Fishery Management Councils and to the NOAA-Fisheries stock assessment team at the Southeast Fisheries Science Center in Miami. Anne-Marie Eklund agreed to collect the data files and reports for that CD.

The working group reviewed the available data and concluded that they were not adequate for an assessment; although since the meeting, a new data-source has been identified that may be useful for assessment purposes (see section E). In general, goliath grouper data are limited as all harvest for goliath grouper has been prohibited since 30 August 1990. In addition, the working group found several problems with the historical fishery-dependent data. The working group developed a prioritized list of information that it believed would be required to develop adequate estimates of stock status.

A. Biology and Life History

Felicia Coleman made a general presentation on life history based on multiple years of research conducted by herself, Anne-Marie Eklund, Chris Koenig, Jennifer Schull and other colleagues. That presentation will be placed on the CD with explanations of the information on each slide. Subsequent discussion reviewed the various research topics in greater detail.

Stock structure

Coleman reported on preliminary results of genetic analyses of goliath grouper from Belize and southwest Florida (conducted by Bob Chapman of South Carolina Department of Natural Resources) which indicate that the fish in those two areas are discrete stocks. Coleman and Chapman are working on size/age of fish from which genetic samples were taken. It was stated that the fish from Florida were small (juveniles) but the size of the fish from Belize was not known.

Age and Growth

Bullock *et al.* (1992) published information on goliath grouper age and growth.

More than 1000 dorsal spines and a small number of otoliths from juvenile goliath grouper in mangrove habitat have been examined (John Brusher and Jennifer Schull from SEFSC). Edge analysis indicates that the observed annuli in spines are formed once a year between July and December (with peak annulus formation from August-November). A comparison of spine and otolith ages from a small number of fish indicates that there are differences of up to one year between the two hard parts. These differences are thought to be due to the different times of year that the two hard parts appear to lay down annuli. Schull and Brusher are currently analyzing the data and adjusting the ageing for date and time of annulus formation.

Study of goliath grouper in mangrove creeks and tidal passes indicates that those caught by crab traps and fish traps and by hooks were primarily ages 1-6 years old (having 1-6 annuli present on otoliths and fin spines). Most of those fish were less than 100 cm TL, while fish from wrecks and reef habitats were greater than 150 cm TL. It was therefore assumed that most of the fish on wrecks and reefs were at least 6 years old. These data on individual fish and comparisons between age readers will be put on the CD.

The panel recommended continued work on ageing. Ages should be standardized to a calendar year, so that information on a year class is treated consistently throughout the year. Corroborative studies between the current research group (Schull and Brusher) and those with previously published age and growth work (Lew Bullock - FMRI) should be continued.

Reproduction

Bullock *et al.* (1992) published information on goliath grouper reproductive biology. They collected ripe fish between July-September and found no indication of sex change in any of the fish collected. Fish were mature between the ages 4 to 7.

Habitat

Felicia Coleman and colleagues (Anne-Marie Eklund, Chris Koenig, Jennifer Schull at meeting) reported that goliath grouper found in mangrove creeks and tidal passes are immature, and mature goliath grouper were thought to be associated with both artificial and natural reef structure, including piers, bridges, artificial reefs, wrecks and natural reefs. They have caught goliath grouper from about 2-100 cm TL (from young-of-the-year to age 6) in mangrove habitat. Those researchers and fishermen (Don DeMaria, Eddie Toomer) reported that fish of about 150 cm TL and larger are usually found around structure such as wrecks, artificial reefs and natural habitat with relief and overhangs. Another fisherman (Peter Gladding) reported that large goliath grouper have been observed on sand bottom in shallow water, beneath vessels.

Felicia Coleman further reported that there are indications that the amount of mangrove habitat in Florida has declined over time, thereby potentially reducing nursery

habitat. There is a student at FSU working on a project to compare historical coastal mangrove coverage to present-day coverage. A student at the University of Florida is evaluating the relative impact of sea-level rise on mangrove distribution. It was noted that black mangrove habitat is newly developing along the Louisiana coast. Although our studies indicate that goliath grouper use primarily red mangrove habitat, goliath grouper occur and have historically occurred along the coasts of Louisiana and Texas; what habitat is used by juvenile goliath grouper in those areas is not known. (NB – during the last day of the workshop, two Texas Fishermen, Matt Murphy and Mike Nugent, reported that goliath grouper are frequently seen under docks off central Texas).

In the southeastern Gulf of Mexico, adult goliath grouper are often observed on offshore wrecks. Information on their distribution and abundance on natural habitat is more limited, possibly because these sites are visited less frequently by many of the dive groups that make and report observations. Goliath grouper may be concentrated around wrecks (isolated areas of high relief) and more spread out on low-relief natural habitat. The number of offshore wrecks has increased over time, thereby potentially increasing the amount of available offshore habitat available for the fish, or simply concentrating the fish on isolated structures. Eddie Toomer presented some interesting footage of goliath grouper on shallow, inshore sites and has offered to take the goliath grouper research team to visit these sites in summer 2003.

Distribution

Most of the current observations of goliath grouper are on wrecks off Charlotte and Lee Counties in southwest Florida. Don DeMaria pointed out that there were aggregations of goliath grouper off the southeast coast of Florida, near Jupiter, in the 1950s. These aggregations were fished-out soon after discovery, and the goliath grouper had not been reported from that area for several decades. However, in 2002, an apparent aggregation of 50 individuals was observed in that same area. Reports of fish in the northeastern Gulf of Mexico and northeast coast of Florida are beginning to come in through the FWC tagging hotline. No spawning aggregations from these northern sites are known.

Movement

Tagging of juvenile goliath grouper in southwest Florida mangrove habitat (mainly in the Ten Thousand Islands) indicates limited movement. Tagging of adults (Koenig *et al.* unpublished data) primarily during the spawning months on presumed spawning sites has shown that a high proportion (>40%) of recaptures occurred at the original tagging site. Analysis of acoustic tagging information at four sites in the Gulf of Mexico (Eklund *et al.* unpublished data) might provide additional quantitative information, but the analyses have not yet been conducted. Information gathered from that study might provide some indication of motility and site fidelity. The acoustic data from the juvenile tagging study in the Ten Thousand Islands area and from offshore tagging will be put on the CD.

Concern was expressed that if the fish do not move much, then the estimates of abundance would be only estimates of a local population and would, therefore, have only limited value in estimating the size of the population at large. Don DeMaria reported that he observed new fish on wrecks within months after removal of fish via spear fishing. This observation was true earlier in his fishing experience, but later, as the overall population was thought to have declined, replacement of removed fish occurred much more slowly. Jim Cowan suggested that it was possible that motility could be directly related to fish density, and as the overall population declined and density decreased, the motility of the fish might also have declined.

Predation

Sharks are the only known natural predator on adult or larger juvenile goliath grouper.

Natural Mortality

It was noted that the estimates of mortality provided from Jolly-Seber analyses of mark/recapture of juveniles (see power point presentation by Felicia Coleman on the CD) are confounded with emigration and gear selectivity. The investigators did not use those estimates of mortality and do not recommend using them. Jim Cowan recommended that alternative analytical methods (MARK software) be considered for use in estimating abundance and particularly the natural mortality rate.

B. Catch

Landings

Landings data from NOAA Fisheries were presented for 1950-1990; the moratorium on goliath grouper landings was imposed on August 30, 1990 [55 FR 25310]. The reliability of the landings data was discussed.

FWC reported that landings prior to 1985 or 1986 from a dealer on the west coast of Florida were substantially inflated for all species. With the advent of the Florida trip ticket system in 1986 this problem was identified, and FWC personnel developed revised catch statistics. It is possible that the NOAA Fisheries data are not corrected for that problem; a noted decrease in the goliath grouper landings in the mid-1980s could be associated with a transition from inflated to actual landings statistics. Josh Bennett will work with Stu Kennedy and Joe O'Hop to determine whether NOAA Fisheries landings data have been corrected or need revision.

Several fishermen reported that goliath grouper catches frequently were not sold through dealers. Prior to the early to mid-1980s, prices were very low (on the order of $0.10 / lb) and a substantial fraction of the catch was thought to have been sold directly to restaurants rather than to dealers. Apparently, in about 1984, prices began to increase and the proportion of the landings sold through fish houses increased. Some goliath

grouper continued to be sold directly to restaurants, even after the imposition of the Florida trip ticket system in 1986. One fisherman from Key West reported that he had caught one to five goliath grouper per trip over many years but had never sold them to a dealer, whereas another Key's fisherman reported that he had always sold fish through dealers. If the proportion of sales of goliath grouper to fish houses increased in the mid-1980's, then the decline in reported landings may actually be an underestimate of the actual decline in catch. It was recommended that estimates of the proportions of sales of goliath grouper to restaurants be made from Florida trip ticket data if possible.

Another concern was that goliath grouper larger than about 150 lbs. were sold without the head. Because NOAA Fisheries landings records historically record whole weight, landings of headed and gutted fish would have been converted to whole weight using a standard set of conversion factors.

One fisherman (Eric Schmidt) estimated that in the Fort Myers, FL area, about 75% of the goliath grouper landings were made by recreational fishermen.

Current (catch and release) mortality

Several fishermen reported that they thought fishing mortality was currently occurring when goliath grouper are caught (when other species are targeted) and when fishermen target (some repeatedly) goliath grouper for catch-and-release. Generally, the goliath grouper population is thought to have increased, but mortality continues as a result of probable release mortality (especially adult specimens brought from depth) and unreported illegal catch.

C. Size and Age Composition

A small number of individual sizes were recorded for goliath grouper in the NOAA Fisheries TIP database (n = 102 total, 28 from the Caribbean area and 74 for mainland US). Investigation of the mainland US records after the Data Workshop revealed that at least 66 of the records were mis-identified gag and snowy grouper (Josh Bennett), thus at most 8 size observations are available in the TIP data base.

Fishery-independent sampling for age and size composition is continuing (1997-present) (Schull and Brusher and other colleagues). Bullock and Smith (1991) and Bullock et al. (1992) also present data on age and size composition from opportunistic sampling during the late 1980s.

D. Effort

Effort directed at goliath grouper reportedly increased during the 1980s (see Amendment 2 to the Gulf of Mexico Reef Fish Fishery Management Plan).

E. Indices of Abundance

Everglades National Park has conducted a survey of recreational fishermen since 1974 (or possibly before), and goliath grouper is likely to have been recorded in the data set. Apparently the survey collects information not only on landings, but also releases, and should be useful for developing an index of abundance. Anne-Marie Eklund will review that data to determine if goliath grouper landings are recorded with sufficient frequency to develop an index.

A relatively short time-series of catch and effort information exists in the Florida trip ticket data for the mid-1980s to August 1990 when the prohibition of harvesting was imposed. These data would be available for analysis if required.

Catch rates have been recorded from 1997-present in the juvenile tagging study conducted in the Ten Thousand Island/ Florida Bay area. The low motility of some of those fish (approx. 40% recaptured, many fish several times) was thought to limit the usefulness of that data as an index for the entire population. These data will be put on the CD.

The Florida Marine Research Institute conducted a trap survey in 2000-2002 along the Southeast Coast; no goliath grouper were caught.

Scott Nichols reported that SEAMAP had recorded only one goliath grouper in many years of sampling with multiple gears.

Diver observations

A series of observations by one diver (Don DeMaria) from 1981 to present at four wrecks from depths of 100-130 feet in the eastern Gulf of Mexico was presented as a possible index of abundance. Don DeMaria was a spear fisherman in the 1970s and 1980s. His written log lists the number of goliath grouper observed on each dive. DeMaria noted that during the earlier part of his log he probably underestimated numbers, because it was difficult to see all of the fish present when there were so many of them. Thus, his earlier numbers would be less precise; the counts in the mid to late 1980s likely included all of the fish observed because far fewer fish were present. It was noted that the pattern in the observations was similar to the pattern of commercial landings. The data and a description of the sampling protocol are provided on the CD.

Several questions were raised about the utility of the time-series for use as an index of abundance. In response to a question about the consistency of the effort, Don DeMaria reported that he thought it was consistent due to limits on dive time at such depths. In response to a question about whether the high number of goliath grouper recorded when a site was first visited (1982 for three of the sites) was accurately representing the number of fish on the wrecks, Don DeMaria responded that he thought the wrecks had not been exploited before he first visited them (they were in deep water and spear fishing had been limited to the shallower inshore wrecks) and that the

observations did represent the number of fish present. It was noted that the wrecks might deteriorate over time and their suitability as habitat for goliath grouper might diminish. One wreck was small and deteriorating; another was a large shipwreck from WWII and was not visibly changing.

The group discussed whether the data from these four small areas could reflect total population trends. Don Demaria noted that inshore wrecks generally were not repopulated after being fished-out while offshore wrecks appeared to repopulate. However, tagging data from 1998-present indicate that fish often continue to be observed at their tagging locale. It was recommended that the tagging data be further examined for indications of site fidelity. There was some discussion that these offshore wrecks might be associated with spawning sites. If they were spawning sites and goliath grouper actually migrate to them, then they might be more reflective of the population in a broader area. There are no data on spawning migrations, however; and acoustic data from Eklund suggest that the majority of the acoustically-tagged fish remain on-site for several months after tagging.

The Florida Marine Research Institute has conducted an underwater visual survey on selected reef tracts in the Florida Keys since 1999. One goliath grouper was seen in 1999, two in 2000, none in 2001, and three in 2002.

The Reef Fish Visual Census information collected by NOAA Fisheries in Miami (and in recent years in cooperation with the University of Miami) consists of replicated observations by pairs of divers in the Florida Keys and extends from 1978 to present. A total of 8 goliath grouper are noted in the data set through 2001. However, there are several more observations in the 2002 data (not analyzed yet). The panel decided that the limited number of goliath observations would likely be of little value so this data will not be included on the CD.

Some time series of observations by recreational divers might be considered for developing indices of abundance. The Reef Educational and Environmental Foundation (REEF) has collected information from recreational divers from 1993-present from sites in Florida and in the Caribbean. Abundance is recorded in the following categories: one, few, several and many. Size of fish is not recorded. Anne-Marie Eklund will request the data from REEF and if obtained will include it on the CD unless the numbers of goliath grouper observations are very low. A time series of observations from dive clubs diving artificial reefs in Florida has been collected by Bill Horn (Florida Fish and Wildlife Conservation Commission, Marine Fisheries Division). Felicia Coleman and Chris Koenig have that data and will attempt to determine whether the data set contains useful effort measures. Without a good measure of effort, the increase in the number of goliath grouper observations is confounded with increases in diving effort and number of artificial reefs placed in Florida waters over time.

F. Estimates of Abundance

Estimates of abundance have been made from juvenile mark-recapture data in the inshore mangrove areas of the Ten Thousand Islands and Florida Bay (Coleman, Koenig and Eklund, in review). Jolly-Seber methods were utilized to estimate population size. It was recognized that these would be estimates of local abundance because of the limited geographic range of the tagging and the low movement rates exhibited (gear selectivity also confounds information on age-class abundance). These data will be included on the CD. Mark-recapture abundance estimates of adult abundance throughout the Florida shelf (east and west coast) have not yet been finalized (Koenig et al.).

G. Estimates of abundance relative to the unexploited condition

Steve Turner (SEFSC) presented a paper by Porch and Scott (2001) detailing a method of estimating time of stock recovery given information or assumptions on the status of spawning stocks relative to the unexploited condition. The group discussed the possibility of using information from fishermen who had fished for goliath grouper in the 1950s or 1960s through the 1980s to provide perspectives on stock biomass decline between a relatively lightly exploited period and the time of the closure of the fishery. The group expressed concern that the results would be so highly variable that they would be unreliable for producing meaningful estimates. Steve Atran reported that the Gulf Council had conducted surveys of opinions about the relative status of goliath grouper in the early 1990s. Anne-Marie Eklund has that information from the Council and will include it on the CD. Several people recommended that log books would provide more reliable estimates than oral history.

H. Population information which might be useful in monitoring future stock status

The group expressed concern that the existing information available for estimating stock status might not be sufficient. The group discussed the types of information which might be useful for monitoring stock rebuilding. Research issues were discussed and categorized into eight research topics. They were then prioritized based on their short term value for assessing goliath grouper stocks Gulf-wide. There was also a request to the Gulf Council and NMFS (Tom McIlwain) to include this research in the next round of grant RFPs.

The top four research topics were:

1. **Estimation of population size** - Estimates of population size were considered to be of highest importance for future management. It was noted that because of the apparent restricted home ranges and high site fidelity, sampling throughout the geographic range would probably be important. Tag/recapture studies were mentioned as a potential monitoring tool. (NB – to better define their geographic distribution, the State of Alabama (http://www.dcnr.state.al.us/mr/goliath_grouper.htm) and the State of Mississippi (http://www.dmr.state.ms.us/Misc/Species-of-concern/) recently put up hotline

notices on their websites. Louisiana plans to add a link to their site, and Texas should follow suit).

2. **Demographics** - Monitoring the demographics of the population, particularly age composition, could provide valuable information (as it has for red drum in the Gulf of Mexico).

3. **Reproductive Biology** - Developing further understanding of the reproductive biology of goliath grouper was considered quite important. Identifying spawning locations, duration and periodicity could be very useful for identifying sites to conduct population surveys.

4. **Historical Abundance** - Obtaining information on historical abundance, perhaps via old logbooks, was also considered important.

Four other research topics were also considered, but it was thought that they were either less important, or less likely to be completed:

1. It could be very useful to have estimates of unrecorded mortality from accidental or intentional sources, but obtaining such information would be very difficult.

2. Additional information on stock structure was considered important.

3. Some thought that it would be useful to have a greater understanding of goliath grouper bioenergetics and trophic relationships. Others asked how that information would assist in a stock assessment.

4. Information identifying the changes in mangrove abundance and distribution, thereby changing available nursery habitat, could assist in developing predictions of future abundance.

Literature Cited

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Appendix 1: Participants and email addresses

Goliath Grouper E-mail List

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